

AN
ESSAY
ON THE
SULPHURET OF LIME,
AS A SUBSTITUTE FOR
POT - A S H;
OR A
NEW METHOD OF
BLEACHING.
TO WHICH IS ADDED,
THE PROCESS OF DISCOVERING
ADULTERATED POT-ASH.

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P O T - A S H, &c. &c.

SINCE I had the honor of being appointed chemist to the Linen Board, which is now more than three years, I have allotted a considerable portion of my time and attention to the investigation of the principles of that science, applicable to the art in which I am thus more particularly interested. It appeared, that until pot-ash could be dispensed with, we must for ever remain in the power of foreign nations as to our staple commodity. Observing also, that all the late improvements in bleaching were exclusively confined to the one object—that of imparting oxygen to the cloth, in a safe and expeditious manner, but that there had been no effort made to supersede the
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necessity of pot-ash, by far the most expensive and uncertain article employed by the bleacher, and for which he is entirely dependent upon foreign markets; I directed my attention chiefly to discover a substitute for pot-ash; which, provided it should be of Irish production, though it might be equally expensive, I conceived would be of the utmost national importance.—Impressed with these ideas, I undertook a series of experiments with that view.

To enumerate the many disappointments and failures I experienced during my investigation, would be endless, and an unnecessary intrusion upon my reader.—Knowing from an important observation of Mr. Kirwan, that saline hepar, or the combination of an alkali with sulphur, might, from its detergent properties be advantageously employed in bleaching, as a substitute for mere alkali, by an obvious analogy I was led to expect a similar effect from calcareous hepar, or, more properly speaking, sulphuret of lime, being a combination of lime and sulphur.

In these expectations I was not disappointed, but at that time (about three years since) I contented myself (rather through necessity, for large cities are very unfavourable to experiments on bleaching by exposure to the atmosphere,) with pointing it out to some of the principal bleachers from the north then in town, earnestly recommending

recommending it to them to give it a fair trial with, and without pot-ash. Since that time, alkaline salts having become progressively dearer, and in consequence of a late proposal of substituting lime for pot-ash, in condensing the oxymuriated gas, I was instigated to resume the subject, and make further and more varied trials. The result of which has been, that the use of the sulphuret of lime may be most advantageously combined with that of the oxymuriated lime, and that thus cloth may be perfectly whitened without the use of a particle of alkali. This then alone would seem to give it a decided preference over the methods at present in use, while at the same time it possesses peculiar advantages, and is exempt from the principal objections, to which other *substitutes* are liable; for 1st, quicklime and sulphur, the materials of which the *calcareous hepar* consists, are both articles of trivial expence, especially as the latter enters but sparingly into the composition; 2dly, their combination is effected in the easiest and most expeditious manner possible, and perfectly level with the capacity of the meanest workman; 3dly, as the manner of its application is, by steeping the cloth in it cold, the saving of fuel is a matter of great magnitude; and lastly, there is no danger to be apprehended in the use of it, from the unskilfulness or negligence of the workmen, as it appears to be incapable of injuring the texture of the cloth.

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The *fulphuret* of *lime* is prepared in the manner following:—Sulphur, or brimstone in fine powder, four pounds, lime well flaked and sifted twenty pounds, water sixteen gallons; these are all to be well mixed and boiled for about half an hour in an iron vessel, stirring them briskly from time to time. Soon after the agitation of boiling is over, the solution of the *fulphuret* of lime clears, and may be drawn off free from the insoluble matter, which is considerable, and which rests upon the bottom of the boiler *. The liquor in this state, is pretty nearly of the colour of small beer, but not quite so transparent.

Sixteen gallons of fresh water are afterwards to be poured upon the insoluble dregs in the boiler, in order to separate the whole of the *fulphuret* from them. When this clears (being previously well agitated) it is also to be drawn off and mixed with the first liquor; to these again, thirty three gallons more of water may be added, which will reduce the liquor to a proper standard for steeping the cloth.

* Although *lime* is one of the constituent principles of the *fulphuret*, yet being so intimately united to the sulphur, it has no longer the property of lime; upon the same principle that *sulphuric acid* in sulphat of pot-ash, has not the property of that acid.

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Here we have, (an allowance being made for evaporation, and for the quantity retained in the dregs) sixty gallons of liquor from four pounds of brimstone.

Although sulphur by itself is not in any sensible degree soluble in water, and lime but very sparingly so, water dissolving but about one seven-hundredth part of its weight of lime; yet the sulphuret of lime is highly soluble*.

On bleaching with the sulphuret of Lime.

THE linen as it comes from the loom is charged with what is called the weaver's dressing, which is a paste of flour boiled in water, and as this is brushed into the yarn of the warp, before it is wove, it is somewhat difficult to separate it when dry. To discharge this paste, the linen must be steeped in water for about forty eight hours, when this extraneous substance undergoes a kind of fermentation, which does not extend to the substance of the linen itself, upon the same principle that the green sap is disengaged from the flax without injury to its texture.

* When the above Proportion of lime and sulphur is boiled with only twelve gallons of water, the sulphuret partly crystallizes upon cooling, and when once crystallized, is not easy of solution.

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When the linen is well washed after this last process, it contains nothing that water can separate; it is of a greyish white colour, although the fibres, of which it is composed, when divested of every adventitious substance, are naturally very white.

The matter, which thus colours the linen, is of a resinous nature, insoluble in water, and from its intimate union or dissemination through the very fibres of the flax, is difficult of separation, even by those substances which have a solvent power over it.

To disengage it however, in as cheap and expeditious a manner as possible, without injuring the texture of the fabrick, is the sole object of the process of bleaching.

When the linen is freed from the weaver's dressing, in the manner already described, it is to be steeped in the solution of sulphuret of lime (prepared as above) for about twelve or eighteen hours, then taken out and very well washed; when dry, it is to be steeped in the oxymuriate of lime for twelve or fourteen hours, and then washed and dried. This process is to be repeated six times, that is, six alternate immersions in each liquor, which I found sufficient to whiten the linen.

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When I submitted the linen to six boilings in pot-ash, and to six immersions in the oxygenated liquor, it was not better bleached than the above.

The three first boilings in pot-ash, it is true, produced a somewhat better effect than as many steeps in the sulphuret; but towards the conclusion, that is, when the linen was bleached, the smallest difference was not observable as to colour. The linen bleached with the pot-ash was thinner, or more impoverished than that treated with sulphuret, and the latter stood the test of boiling with soap much better than the former, although it did acquire a slight yellowish tinge, which I should suppose a week's, or at most, a fortnight's grass, as they term it, would remove.

I contrasted the effects of hot and cold sulphuret in various temperatures, and although the difference appeared in favour of the hot liquor, yet it was so trifling as not to deserve consideration, or the expenditure of the smallest quantity of fuel.

When I steeped the linen in the sulphuret first, and afterwards boiled it in pot-ash, and then immersed it once in the oxygenated liquor, a better effect was produced, than from two previous boilings in pot-ash, or from two steeps in the sulphuret; so that the two substances seem to co-operate with each other.

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Indeed, from what I have seen, two successive steepings in fresh sulphuret, previous to the immersion in the oxygenated liquor, seemed to afford very little better effect than a single one, which is not the case with respect to pot-ash.

It was observable, that the cloth was invariably thicker or more swelled coming out of the sulphuret, than after being boiled in pot-ash, and remained so when even washed and dried.

It appears to me, that the sulphuret opens the fibres of the linen more speedily and better than the latter, by softening and swelling, rather than by dissolving, the resinous or colouring matter. This accounts for the better effect of pot-ash upon the linen when previously steeped in the sulphuret, than when used by itself.

Probably those bleachers, who do not at present find it convenient to use the oxygenated liquor, but continue to bleach by exposure to air, may derive some advantage from this, by using the sulphuret and pot-ash conjointly or alternately.

Mr. John Duffy, of Ball's-bridge, (who from his knowledge of chemistry is very well acquainted with the principles of bleaching) was kind enough to repeat the above experiments, and his report to me corresponded with my own observations.

It is almost impossible to ascertain to the full extent, more especially by small experiments in an laboratory, the many advantages any substance not hitherto used in bleaching, will afford by varying the mode of application.

The experimenter does a great deal by discovering the efficacy, proving the practicability, and ascertaining the safest and most economical method of directly using it, and also the best proportion of it. Before he can arrive at any one of these, many a round of changes are necessary; indeed a greater number than any man who is not used to experiments can be aware of. But I should hope, that the bleacher need not hesitate to use it in the state in which I present it to him, more especially as he runs no risque of injuring the cloth with it. If he can make more of it hereafter, I shall feel happy upon the occasion; no discovery was ever brought to perfection at once.

How gradually, and yet how progressively the steam engine, from its first invention by the Marquis of Worcester, was brought to its present degree of perfection? Undoubtedly, it was just so with respect to alkalies, the substances now used by the bleachers; it must have taken a considerable time after their first application in bleaching, before they could be made the most of.

I will now conclude by pointing out the advantage likely to accrue from the use of the sulphuret, to the nation, and also the saving to the individual.

By the information I have had from the Custom House, it appears that the average importation of pot-ash, pearl-ash and barilha, the last twelve years, amounts to about 5066 tons annually; about one half of this, (2533 tons) is barilha. The average price of barilha the last three years, has been forty pounds a ton, so that the value of the quantity imported is 101,323 pounds; of this only half, or thereabout, I understand, is used in bleaching, the remainder being converted into soap.

Most of the pot and pearl-ash is consumed by the bleachers, and the average price of it, the last three years, has been sixty-five pounds a ton, consequently, the value of 2,533 tons is 164,645 pounds.

Hence it seems, that the quantity of foreign alkalies imported into the Kingdom every year, amounts to 265,968 pounds; and that the quantity used in bleaching alone, amounts to about 215,307 pounds annually.

The average price of brimstone for the last three years, is about twenty-five pounds a ton, which is at the rate nearly of two pence farthing a pound; four

four pounds of brimstone, and twenty pounds of lime, as already observed, will produce sixty gallons of liquor. In this country, twenty pounds of lime may be valued at about four pence, so that the bleacher may have the sixty gallons at the expence of 1s 1d.

By what I could learn from different bleachers, the common allowance of alkali for sixty gallons of water, is six pounds of barilha or four pounds of pot-ash at the very least, and most bleachers use more than this. The price of four pounds of pot-ash at the rate of sixty-five pounds a ton, is about two shillings and four pence, which is two pence more than double the price of the sulphuret; but as the brimstone must be ground, an allowance should be made for it; and being easy of pulverization, a farthing per pound is an ample consideration for the expence attending it.

The saving of fuel only remains now to be taken into consideration; and as this cannot be calculated with any degree of accuracy, I shall content myself by particularizing facts. In the first place, but sixteen gallons of liquid are to be boiled in preparing sixty gallons of the sulphuret, while the whole sixty gallons must be boiled when the alkali is used; hence it might appear that two thirds of the fuel are saved in the quantity of liquor, but it is not quite so much, suppose we estimate it at one half, which is rather under-rating it. Let us add to this
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the time necessary to boil the different liquors; the sulphuret requires but about half an hour, and the alkaline lixivium at the very least, seven hours to boil the linen in it, which is in the proportion of one to fourteen.

The saving altogether to the bleacher from this statement, is obviously very considerable; and as the Wicklow copper mines are sufficient to supply the whole kingdom, or indeed two such kingdoms with abundance of sulphur, let the consumption be ever so great, the entire of the alkali, or 215,307 pounds must be annually saved to the nation.

But suppose two-thirds only of the quantity of alkali generally consumed in bleaching were dispensed with by the use of the sulphuret (which is a supposition not warranted by my experiments) still the saving to the nation and to the individual, must evidently be great indeed.

How to discover adulterated Pot-ash

As pot-ash is the principle agent in the bleaching of linen, no foreign article imported into this country deserves more attention.

Pearl

Pearl or pot-ash contains from 10 to 12 per cent. of impurities, mostly sulphat of pot-ash, and sometimes a small portion of muriate* of pot-ash. These salts must have been yielded by the wood, and dissolved by the large quantity of water necessary to separate the pot-ash from the ashes.

I more than once obtained near 20 per cent. of sulphat of pot-ash from the pearl-ash imported here; this great portion of sulphat of pot-ash could have never been a natural product, but must have been an artificial adulteration; and indeed, circumstances have convinced me that it must be so.

During a mineralogical excursion through England in the summer and autumn of the year 1785, the different manufactures, which fell in my way, were not passed over. Upon enquiring of the distillers of aquafortis (nitrous acid) how they disposed of the large residuum left in the still (when the acid was carried over) which is sulphat of pot-ash, and which is of little or no use in the arts, they informed me it was bought up by the Irish merchants.

Sulphat of pot-ash, when ground down, cannot readily be distinguished as to its external appearance from pearl-ash, and being so much cheaper than the latter, is well calculated for the above fraudulent purpose.

* Muriate of pot-ash, a neutral salt, consisting of marine acid and pure pot-ash.

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By no means do I intimate that this is a common practice, as from experience I know the contrary.

However, to pass it over in silence would be unpardonable, when it is considered that the bleacher is at the expence of an article of no use whatever in bleaching, and that, by the adulteration, the proportion best known by experience to answer his purpose is varied; by which means his process, although not altogether frustrated, must be materially retarded.

Sulphat of pot-ash is only soluble in about sixteen times its weight of water, in the temperature of 60° , while real pot-ash is soluble in its own weight of water, in the same temperature; hence they are easily separated in the following simple manner, viz. three pounds of pearl-ash and two quarts of water should boil together for a few minutes, then be removed from the fire and suffered to stand for twenty-four hours, when the clear liquor is to be decanted off. Half a pint more of cold water is to be poured upon the dregs, and this again drawn off when clear: the insoluble salt is afterwards to be well dried and weighed, which, being a foreign salt, will give pretty nearly the quantity of impurities in the pot-ash.

The purest pot-ash imported always contains, as I have before observed, a certain quantity of sulphat of pot-ash (vitriolated tartar); and this
quantity

quantity is no doubt the natural production of the vegetable itself, which affords the pot-ash. Some muriate of pot-ash (regenerated sea salt) has occasionally been found in it; but in portions too inconsiderable to injure any art or manufacture, in which pot-ash is used.

Within the last year however I have discovered, to my great surprize, in several specimens of pot-ash, which I have examined for the bleachers, a large quantity of muriate of soda (common sea salt). The last specimen of this sort was examined by my pupils, under my own immediate inspection, in the Laboratory of the Dublin Society, and it afforded upwards of one-fifth of foreign salt; the proportion being as follows.

	Grs.
Aerated (mild) pot-ash -	1690
Muriate of soda -	270
Sulphate of pot-ash -	200
Total -	2160

This last analysis was made for a Mr. Harrison, an eminent glass manufacturer at Belfast, who had suffered very materially in his manufacture, by the adulteration of his pot-ash; and I have no doubt, that rock salt, which is the same as common salt, but much cheaper than that which is prepared for commerce, was mixed in powder with the pot-ash previous to

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its importation. Muriate of soda, being besides much more soluble in water, than sulphate of pot-ash, is less easily detected, and separated from the pot-ash.

The following is the method, which I adopted for determining the nature and proportion of the ingredients.

The specimen having been first weighed, was digested for a few minutes on a sand bath, in twice its weight of water, in a heat of about 212, and instantly stirred. It was then removed from the sand bath, and before it cooled to the temperature of the atmosphere, filtered through paper. As soon as all the liquor had passed through the filter, a small quantity of cold water was poured, from time to time, upon the saline residuum upon the filter, in order to wash through the whole of the pot-ash. The undissolved salt, which was sulphate of pot-ash, was afterwards dried and weighed. In the clear solution, however, there remained, not merely the pot-ash, but, such salts as possessed sufficient solubility to be taken up along with it by the water, though in fact not so soluble as the pot-ash itself. To get at these the following means were used: the clear solution was evaporated down a little on the sand bath, and set by in a cold place for 24 hours: at the end of which time, a quantity of common salt was found crystallized

crystallized in regular cubes at the bottom of the vessel. From these the liquor was perfectly drained, and being preserved, the same process was repeated, till there ceased to be any deposition of cubic crystals.

Before the muriate of soda, thus procured, was weighed, some muriatic acid was poured on it, in order to take up any of the pure pot-ash, which might have adhered to it during its crystallization. The muriatic acid, with such of the pot-ash as it had found and dissolved, was then drained off and thrown away, and the muriate of soda dried and weighed. The sum of the impurities being then subtracted from the weight of the specimen, the quantity of the pot-ash was ascertained.

This new species of adulteration must be a great drawback on our staple manufacture, and deserves therefore very serious consideration.

ADULTERATED POT-ASH

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